Sterility in Crosses of Geographical Races of Drosophila micromelanica

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one had the bases of petioles sliced and bruised; one had 1% indole butyric acid in lanolin applied to the upper surface of the tips of the leaves; and a fourth had the bases of the petioles wounded and 1% indole butyric acid applied to the leaf tips. The results are given in table 5.

The effect of wounding appears to be nearly as great as that of the application of indole butyric acid. The combined effect of wounding and the use of indole butyric acid is not greater than that of indole butyric acid alone.

Summary.—1. In petioles of Coleus and in herbaceous cuttings of some other species wounding greatly increases the production of adventitious roots.

2. Treatment with extracts which contain wound hormones strongly stimulates root formation in woody cuttings.

3. Both wounding and treatment with extracts containing wound hormones shorten the time required for rooting of cuttings.

4. The effect of wounding on root initiation appears to be nearly as great as that of treatment with indole butyric acid.

[1] Bonner, J., *Proc. Nat. Acad. Sci.*, **22**, 426 (1936).

[2] LaRue, C. D., Papers, *Mich. Acad. Sci., Arts and Let.*, **22**, 123–139 (1936).

[3] Warner, C. C., and Went, F. W., *Rooting of Cuttings with Indole Acetic Acid and Vitamin B*$_1$, pp. 1–12, Plant Culture Publishing Co., Pasadena, California (1939).

STERILITY IN CROSSES OF GEOGRAPHICAL RACES OF DROSOPHILA MICROMELANICA[1]

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Drosophila micromelanica Patterson is a member of the subgenus Drosophila, related both to *D. melanica* and to *D. mulleri*. It has been found by Professor J. T. Patterson "throughout central Texas," and two separate collections have been made in the Huachuca Mountains of southern Arizona (C. Epling, G. Mainland).

We have studied two Texas strains (Austin, Smithville—both from Professor Patterson) and two from Arizona (collected by Professor C. Epling). These are phenotypically indistinguishable and have identical metaphase chromosome groups (five pairs of rods that are approximately equal in length, and a pair of dots).

Crosses have shown that Arizona ♀ × Texas ♂ yields fertile males and females, but Texas ♀ × Arizona ♂ yields fertile females and sterile males.

Further experiments indicate that the sterility of these males is dependent on their possession of a Texas X and an Arizona Y (cf. the similar case in *D. macrospina*, briefly reported by Mainland[2]).

In the Austin stock two sex-linked mutant types have been found—white and echinus. Linkage tests have given 49.1% (285/580) recombination between the genes concerned. An Arizona wild-type chromosome, tested against a (Texas) white echinus one, gave 58/123 = 47.9% recombination. The fathers in this case were Arizona males, the mating being thus Arizona/*w ec* × Arizona. Tests were made on some of the sons from this mating, with the result shown:

	+	*ec*	*w*	*w ec*
Fertile	7	9	1	0
Sterile	1	0	8	7

Evidently the difference between the two X's lies near the locus of white —this being the critical evidence that X is concerned. The evidence that Y is concerned is less direct, being derived chiefly from the observation that, in a number of different complex experiments, strains that were largely Arizona in origin but had Texas Y's have given no sterile males when crossed to Texas females.

The nature of the sterility in these males is not clear. They regularly inseminate females, and such females are found to have active sperm in their receptacles. The resulting eggs have never been observed to hatch, and no considerable development occurs in them. It remains uncertain whether they are fertilized, and whether any cleavage divisions occur.

Preliminary observations on the salivary gland chromosomes of Texas-Arizona hybrids indicate normal pairing of homologues, and inversions in only two of the four long autosomes that are present. In one of these there is a single inversion; in the other there are three, of which two are overlapping and the third is independent of both of these. There are no inversions in the X. The genetic data also indicate that there are no inversions in the X, since the recombination frequencies recorded above are not significantly different in pure Texas females and in hybrids. Hybrid females have also given a total of 235 sons in matings where patroclinous males would have been detected, and no such males have been seen. It should be added that no systematic survey has been made of the salivary gland chromosomes; other hybrids may show more or fewer inversions than the ones studied.

Summary.—Strains from central Texas and from southern Arizona are not distinguishable, but when they are crossed the hybrid males from Texas ♀ × Arizona ♂ are sterile; all other F_1 hybrids are fully fertile. The sterility is due to the presence of a particular portion of a Texas X chromosome and (probably) an Arizona Y. The sterile males inseminate

their mates with active sperm, but no larvae develop in eggs laid by these females.

[1] This species is undescribed. Professor J. T. Patterson has furnished the following brief description. A more complete one will be published later.

"*Drosophila micromelanica*, sp. nov.

"A small, very dark melanica-like species with the following general characters: Arista with eight branches; acrostichal hairs somewhat irregular, in six to eight rows; no prescutellars. Spermathecae almost transparent, not chitinized; ventral receptacle emerges from uterus as straight tube and then forms a tangled mass, without definite coiling. The eggs have two filaments. Length of body 2.4 mm.; wing 3 mm. (measurements made on live specimens)."

[2] Mainland, G. B., *Genetics*, **26**, 161 (1941).

LINKAGE STUDIES OF THE RAT (RATTUS NORVEGICUS) V

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I. The Albino Chromosome.—The rat chromosome which contains the largest number of known mutant genes is the one which carries the albino gene. Albinism was probably the first observed mutation of the rat and albinos had long been reared in captivity before the Mendelian laws were known. Albinism in the rat, as in other rodents, is a simple recessive in heredity, as are also the four other mutations which are linked with it. The five mutant genes (as we shall presently show) are in the order of their location in the chromosome (1) *l*, a lethal recently discovered by Grüneberg; (2) *c*, albino; (3) *r*, red-eyed yellow; (4) *p*, pink-eyed yellow; and (5) *w*, waltzing. The heredity of *c*, *r* and *p* was studied by Castle, Wright, Dunn and Wachter, the first observed case of linkage in the rat having been reported by Castle and Wright as occurring between *r* and *p*. Further intensive studies made by Castle, Dunn and Wachter, showed that *r* was closely linked with *c* with less than one per cent of crossing-over between them and that *p* was more loosely linked with *c*. The fact was also established that crossing-over in this chromosome (as in the albino chromosome of mice) occurs with greater frequency in female than in male individuals. The linkage maps involving the three genes were accordingly drawn thus:

	C	*R*	*P*
For females	0	0.5	21.9

	C	*R*	*P*
For males	0	0.2	18.4